

What is claimed is:

1. A lithium secondary cell, comprising:

an internal electrode body including a hollow  
cylindrical winding core, a positive electrode plate and a  
negative electrode plate wound around an external periphery  
wall of the hollow cylindrical winding core with a separator  
disposed therebetween, a nonaqueous electrolyte solution  
impregnating inside the internal electrode body; a  
cylindrical cell case being opened at both ends for housing  
the internal electrode body; and two electrode caps sealing  
the above described internal electrode body at both ends of  
the cell case,

wherein two electrode caps seal the above described  
internal electrode body at both open ends of the cell case;

wherein each of the electrode caps is provided with a  
plate member sealing said internal electrode body and  
disposed so as to seal both open ends of the cell case, an  
terminal member protruding onto the surface of the above  
described electrode caps to lead out currents to outside,  
and an internal terminal member brought into connection with  
the internal electrode body and taking out currents from the  
internal electrode body; and

wherein at least two members selected from the group  
consisting of the plate members, the external terminal  
members and the internal terminal members are joined together  
for construction.

2. The lithium secondary cell according to claim 1, wherein at least one of said plate member, said external terminal member, and said internal terminal member is one produced by press processing or cold forging.

5 3. The lithium secondary cell according to claim 1, wherein at least two of said plate member, said external terminal member and said internal terminal member are produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping and forging clamping, and any  
10 combination of those methods.

4. The lithium secondary cell according to claim 1, wherein at least one of said electrode caps has a pressure release hole in a position corresponding with the central axis of said winding core.

15 5. The lithium secondary cell according to claim 1, wherein the central axis of said winding core is coaxial with the central axis of said cell case.

6. The lithium secondary cell according to claim 1, wherein said external terminal member has a hollow portion so that  
20 said hollow portion functions as a pressure release path of said pressure release hole.

7. A lithium secondary cell, comprising:

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an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; a cylindrical cell case being opened at both ends for housing the internal electrode body; and two electrode caps sealing the above described internal electrode body at both ends of the cell case,

wherein each of two electrode caps is provided with a plate member sealing said internal electrode body and being disposed so as to seal both open ends of the cell case, an external terminal member protruding onto the surface of the electrode caps to lead out currents to outside, an internal terminal member brought into connection with the internal electrode body and taking out currents from the internal electrode body, and an elastic body; and

wherein at least two members selected from the group consisting of the plate members, the external terminal members and the internal terminal members are joined together for construction.

8. The lithium secondary cell according to claim 7, wherein said elastic body is sandwiched among any of said plate member, said external terminal member and said internal terminal member respectively.

10. The lithium secondary cell according to claim 7, wherein said elastic body has electric resistivity of not less than  $10^{10} \Omega/\text{cm}$ .

10. The lithium secondary cell according to claim 7, wherein said elastic body has electric resistivity of not less than  $10^{10} \Omega/\text{cm}$ .

12. The lithium secondary cell according to claim 7, wherein the deformation amount in direction of pressure application for bonding of said elastic body attached by pressure application for bonding is larger than the spring back amount, and said force of pressure application for bonding applied to said elastic body is not more than the quantity of force making said elastic body hold elasticity maintenance percentage of 95% or more.

12. The lithium secondary cell according to claim 7, wherein the deformation amount in direction of pressure application for bonding of said elastic body attached by pressure application for bonding is larger than the spring back amount, and said force of pressure application for bonding applied to said elastic body is not more than the quantity of force making said elastic body hold elasticity maintenance percentage of 95% or more.

13. The lithium secondary cell according to claim 7, wherein said elastic body is made of any of ethylene polypropylene rubber, polyethylene, polypropylene and fluoro-resin.

15. The lithium secondary cell according to claim 7,  
wherein:

at least two of said plate member, said external terminal member, and said internal terminal member are produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping and forging clamping, and any combination of those methods.

17. A lithium secondary cell, comprising:

an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery

wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; a cylindrical cell case being opened at both ends for housing the internal electrode body; and two electrode caps sealing the above described internal electrode body at both ends of the cell case,

wherein each of the electrode caps is provided with a plate member sealing said internal electrode body and disposed so as to seal both open ends of the cell case, an external terminal member protruding onto the surface of the electrode caps to lead out currents to outside, an internal terminal member brought into connection with the internal electrode body and taking out currents from the above described internal electrode body, and an elastic body being sandwiched between the plate member and the external terminal member, and between the plate member and the internal terminal member so as to absorb impact of pressure application for bonding between the plate member and the terminal member; and

wherein a fixing material is disposed so as to apply pressure for bonding the plate member, the terminal member and the elastic body at a predetermined position.

18. The lithium secondary cell according to claim 17, wherein said elastic body insulates the positive electrode and the negative electrode electrically.

19. The lithium secondary cell according to claim 17,  
wherein said elastic body has electric resistivity of not  
less than  $10^{10}$   $\Omega/\text{cm}$ .

20. The lithium secondary cell according to claim 17,  
5 wherein said elastic body is made of at least two kinds of  
packing having different levels of hardness.

21. The lithium secondary cell according to claim 17,  
wherein the deformation amount in direction of pressure  
application for bonding of said elastic body attached by  
10 pressure application for bonding is larger than the spring  
back amount, and the force of pressure application for  
bonding applied to said elastic body is not more than the  
quantity of force making said elastic body to hold elasticity  
maintenance percentage of 95% or more.

22. The lithium secondary cell according to claim 17,  
15 wherein said elastic body is made of any of ethylene  
polypropylene rubber, polyethylene, polypropylene and  
fluororesin.

23. The lithium secondary cell according to claim 17,  
20 wherein a part of the inner periphery wall of said fixing  
material has an inclination toward the outer periphery wall  
of said terminal member.

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24. The lithium secondary cell according to claim 23,  
wherein said inclination is not more than 30°.

25. The lithium secondary cell according to claim 17,  
wherein hardness of said fixing material is the same as or  
5 larger than hardness of said terminal member.

26. The lithium secondary cell according to claim 25,  
wherein said fixing material and said terminal member are  
made of any of Al, Al alloy, Cu, Cu alloy, brass and stainless  
steel.

10 27. The lithium secondary cell according to claim 17,  
wherein said terminal member has a stopper structure in order  
not to apply to said elastic body not less than constant force  
of pressure application for bonding.

15 28. The lithium secondary cell according to claim 17,  
wherein with the central axis of said terminal member being  
an axis,  $r_1$  (mm) being the radius of the upper end of said  
terminal member and  $r_2$  (mm) being the inner diameter of the  
upper end of said fixing material when the side on which said  
fixing material is disposed is placed upper than the position  
20 of said plate member being a reference,  $r_1$  and  $r_2$ , preferably  
fulfill  $r_1 > r_2$ .



29. The lithium secondary cell according to claim 28, wherein when  $\Delta r(\text{mm})$  is a difference between said  $r_1(\text{mm})$  and said  $r_2(\text{mm})$ ,  $\Delta r$  fulfills relationship of  $\Delta r \geq 0.2 \text{ mm}$ .

30. The lithium secondary cell according to claim 17, wherein with the central axis of the terminal member being an axis, when the side on which said fixing material is disposed is placed upper than the position of said plate member being a reference, the upper end of said terminal member protrudes from the upper end of said fixing material.

31. The lithium secondary cell according to claim 17, wherein with  $M_1(\text{ton})$  being force to extract press-inserted said fixing material and  $M_2(\text{ton})$  being elastic force of said elastic body,  $M_1$  and  $M_2$  fulfill relationship of  $M_1 > M_2$ .

32. The lithium secondary cell according to claim 31, wherein said  $M_1$  and said  $M_2$  fulfill relationship of  $M_1 \geq M_2 \times 2$ .

33. The lithium secondary cell according to claim 31, wherein said  $M_1$  fulfills relationship of  $M_1 \geq 1(\text{ton})$ .

34. The lithium secondary cell according to claim 17, wherein the upper end surface of said terminal member is concave.

35. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;

wherein a positive electrode external terminal member of one of the plurality of the lithium secondary cells and a negative external terminal member of the lithium secondary cells other than said one of the plurality of the lithium secondary are brought into connection with a bus bar.

36. The connecting structure body of a lithium secondary cell according to claim 35, wherein at least one of said electrode caps for each cell has a pressure release hole, respectively.

37. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is bonded with a cell not so as to blockade said pressure release hole.

38. The connecting structure body of a lithium secondary cell according to claim 35, wherein:

said pressure release hole is disposed in a position corresponding with the central axis of said winding core;

5 the central axis of said winding core is coaxial with the center axis of said cell case;

said external terminal member has a hollow portion and said hollow portion is structured for use as the pressure release path of said pressure release hole; and

10 said bus bar has a shape not to blockade said hollow portion.

39. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is bonded with said external terminal member by welding.

15 40. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection with bus bars a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical  
20 winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution  
25 impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;

wherein the bus bar and the external terminal member are bonded by welding, and the bus bar and the external member are made of same kind of metal.

41. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection with bus bars a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;

wherein the bus bar and the external terminal member are bonded by welding, and a portion of the bus bar being welded with the external terminal member and a portion of the external member being welded with the bus bar are made of same kind of metal.

42. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Al or Al alloy; and

said bus bar is made of one member containing Al as a major component.

43. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Cu or Cu alloy is used for; and

said bus bar is made of a member containing Cu as a major component.

44. The connecting structure body of a lithium secondary cell according to claim 41, wherein:

said external terminal members of a positive electrode and a negative electrode are made of Ni or Ni alloy; and

said bus bar is made of a member containing Ni as a major component.

45. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection, by way of bonding by welding a plurality of the bus bars and the external terminal members, a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing said internal electrode body;;

wherein the bus bar is formed by bonding different kinds of metals.

46. The connecting structure body of a lithium secondary cell according to claim 45, wherein:

5       said external terminal member in the positive electrode is made of Al or Al alloy, and said external terminal members of the negative electrode are made of Cu or Cu alloy; and

10       said bus bar is formed by bonding a member containing Al as a major component and a member containing Cu as a major component.

47. The connecting structure body of a lithium secondary cell according to claim 45, wherein:

15       said external terminal of the positive electrode is made of Al or Al alloy and said external terminal of the negative electrode is made of Ni or Ni alloy; and

      said bus bar is formed by bonding a member containing Al as a major component and a member containing Cu as a major component.

20   48. The connecting structure body of a lithium secondary cell according to claim 35, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive  
25   welding and close fit, and any combination of those methods.

49. The connecting structure body of a lithium secondary cell according to claim 40, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive welding and close fit, and any combination of those methods.

50. The connecting structure body of a lithium secondary cell according to claim 41, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive welding and close fit, and any combination of those methods.

51. The connecting structure body of a lithium secondary cell according to claim 45, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive welding and close fit, and any combination of those methods.

52. An assembly of lithium battery cells which comprises a plurality of lithium secondary cells and a plurality of bus bars bringing into connection a plurality of lithium secondary cells each of which comprises an internal electrode body including a hollow cylindrical winding core, a positive electrode plate and a negative electrode plate wound around

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an external periphery wall of the hollow cylindrical winding core with a separator disposed therebetween, a nonaqueous electrolyte solution impregnating inside the internal electrode body; and a cylindrical cell case housing the internal electrode body;

wherein a positive electrode external terminal member of one of the plurality of the lithium secondary cells and a negative external terminal member of the lithium secondary cells other than said one of the plurality of the lithium secondary cells having are brought into connection with a bus bar.

53. The connecting structure body of a lithium secondary cell according to claim 52, wherein said bus bar is a one produced by a method selected from a group consisting of friction bonding, brazing, welding, clamping, and forging clamping, press-insertion, enveloped casting, explosive welding and close fit, and any combination of those methods.